Active Project (2014 - 2015)

Magnetic Shape Memory Alloy Actuator for Instrument Applications Project

ABSTRACT

This project will develop a simple actuator based on magnetic shape memory alloy (MSMA), a novel new family of crystalline materials which exhibit strain deformation >10% when subjected to a magnetic field. These materials have the unique property of retaining their strained state when the driving field is removed, making them unique in the world of shape memory materials, and desirable as an actuator material as they will maintain position when powered off. MSMA can potentially replace current shape memory alloys in many spaceflight instrument applications, as well as enable new precision mechanism types.

ANTICIPATED BENEFITS

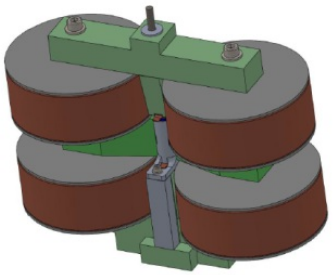
To NASA unfunded & planned missions:

The application of MSMA actuators can be applied to earth science, space science, heliophysics, CubeSat and other SmallSat-class instruments.

DETAILED DESCRIPTION

The objective of this project is to develop a simple, small linear actuator system using magnetic shape memory allow capable of self-position sensing and power-off position maintenance. The actuator system will consist of a laboratory bench-top linear actuator, breadboard-level control electronics, and a computer command interface. The effort is a technology maturation of MSMA mechanisms, which are currently at TRL 2/3, and we intend to bring them to TRL 4. Boise State University (BSU) is a research partner and will provide MSMA crystals and contribute design consultation.

The innovative elements of this technology lie in the use of MSMA, which combine many very desirable properties lacking in other shape memory alloy materials. Similar to conventional SMAs, MSMA exhibit a large, reversible shape change related to a crystal structural transformation. Unlike conventional SMAs,



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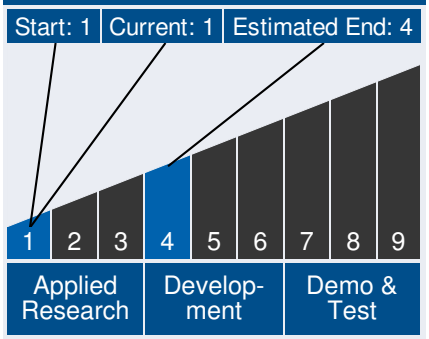
Technology Maturity



Management Team

Program Executive:

- Peter Hughes

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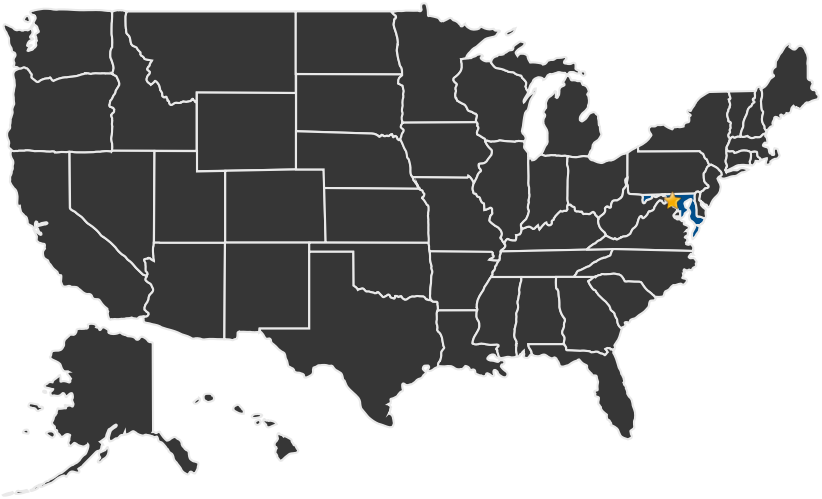
which utilize temperature or voltage as the control parameter, MSMAs are driven by a magnetic field. Fields can be applied with very short response times making MSMA-based actuators kHz capable. Furthermore, the magnetic-field-induced deformation is permanent, and reversible. Holding a constant position does not require power. Also, positioning is highly precise with accuracy in the nanometer range. These properties of MSMA-based actuators will increase the accuracy of earth and space science instruments and reduce operational power consumption.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Goddard Space Flight Center

Contributing Partners:

- BOISE STATE UNIVERSITY

Management Team *(cont.)*

Program Manager:
- Michael Johnson

Project Manager:
- Michael Viens

Principal Investigator:
- Umeshkumar Patel

Technology Areas

Primary Technology Area:
Smart Flexible Material (TA 12.1.3.3)

Secondary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)

Other Technology Areas:
- Materials, Structures, Mechanical Systems and Manufacturing (TA 12)
- Materials (TA 12.1)

Magnetic Shape Memory Alloy Actuator for Instrument Applications Project

DETAILS FOR TECHNOLOGY 1

Technology Title

Magnetic Shape Memory Alloy based Linear Actuator

Technology Description

This technology is categorized as a hardware component or part for unmanned flight

A simple, small linear actuator system using magnetic shape memory capable of self-position sensing and power-off position maintenance.

Capabilities Provided

A linear actuator system capable of self-position sensing and power-off position maintenance.

Potential Applications

The application of MSMA actuators can be applied to earth science, space science, heliophysics, CubeSat and other SmallSat-class instruments.